

Inquiry Lab: What factors affect reflexes and reaction times?

Your mission is to design an experiment, which will examine what things can affect reflexes and reaction times using the skills you learned such as reflex testing, using the reflex hammer, the Jendrassik maneuver, the pupil reflex, and testing someone's reaction time.

Did you ever wonder if your reaction time is faster or slower at different times of the day? What other types of changes can affect reaction time? What could make a difference?

Start by stating a problem or making a statement to be investigated? For example "I believe that a full moon will affect reaction time." (You cannot use that one.) Then decide what steps need to be performed to test or investigate the problem. For example, you could test a person's reaction time during a full moon, the day before a full moon, etc. When you are composing your procedure, you need to figure out how to make sure you are only testing one variable at a time.

You will work with a partner(s) in constructing the experiment and gathering data, but every person needs to write their own report

The following guidelines are for your safety and success.

1. All lab safety rules must be followed.
2. The teacher must check your problem and experimental procedure and approve it **before you begin.**
3. Every person has the right to refuse to be a test subject! Make sure you ask permission before you test somebody for any type of test reflex or reaction time. For example, if you are going to check a patellar reflex, you must ask the test subject for permission first, and also ask if they have any problems with the area to be tested. (Who knows maybe they had a nasty crash on their skateboard yesterday, you don't want to make it worse!!!)

Inquiry lab: What affects reflexes and reaction times?

Format for lab Write-up

Your lab report will have six sections.

I. Title: Title should be descriptive (describe the main idea of the experiment that was done). This should be short (less than ten words). Include your name first then follow with name of your lab partner.

II. Problem: State the reason the experiment was done. What was the experiment designed to investigate?

III. Materials: List all the materials which were used in the experiment including the safety equipment.

IV. Procedure: Summarize the experimental methods which were used to perform the experiment or test.

V. Results: Display results of your experiment. Include **tables** that display the data you collected. Also, create a **graph** with reaction time on the 'Y axis and the factors you wanted to examine on the x-axis.

VI. Conclusions: State what you can conclude from the results. Deal directly with the data here. Discuss how the data you collected explains, reinforces or does not reinforce the statement of the problem which you made in part 11.

STS PROJECT

Spinal Cord Injuries and Society

The purpose of this project is for you to investigate one possible solution for the treatment of spinal cord injuries. There are different approaches to the problem of fixing the spinal cord or figuring out a way for a person to live an independent life without an intact cord. One approach is to use electrical technology and computers to stimulate the muscles of the legs and arms. Remember when I demonstrated the muscle stimulator in class? It was able to move my hand in response to electrical stimulation of the nerves. A much more complex system is Functional Electrical Stimulation or FES. Another approach to treating these injuries is to use stem cells to repair the damaged areas of the spinal cord. Human embryonic stem cell research is a controversial subject that is constantly in the news. Your generation will have to figure out how this technology will be used. By researching this you will be able to make informed decisions when it comes time to cast your vote.

Some areas you may want to investigate:

- Current technology in FES: how does it work, can it allow total movement and independence, how widely used is it as a treatment?
- How are stem cells used to repair injured spinal cord/
- Where do stem cells come from?
- Why is the use of embryonic stem cells controversial? How do you feel about the issue?
- How much is this going to cost? Who deserves to have this paid for? If someone committed a crime, do they deserve to have the treatment paid for?

When using the web to search for information you might want to do a search on stem cells, but narrow it to the issue of spinal cord injuries and treatment.

STS: Websites to help you get started.

<http://faculty.washington.edu/~chudier/free.html>

These websites deal with stem cell technology:

[http://my.webmd.com/content/article/Z-0/~172852645?src=inktomi&condition=Home & Top Stories](http://my.webmd.com/content/article/Z-0/~172852645?src=inktomi&condition=Home&TopStories)

[http://www.sci-info-pages.com/stem cells.html](http://www.sci-info-pages.com/stemcells.html)

These websites deal with FES:

[http://depts.washington.edu/rehab/-sci`/functional electrical stim.html](http://depts.washington.edu/rehab/-sci`/functional_electrical_stim.html)

<http://www.differentstrokes.co.uk/functionalelectricalstim.html>

<http://www.makoa.org/nscia/index.html>

General information on spinal cord injuries:

<http://www.spinalcord.uab.edu>

Rubric for STS project Spinal cord injuries and society.

1. Select a topic to investigate by 3/9/04
2. Choose from writing a paper, constructing a poster or PowerPoint presentation to present your findings.

Project guidelines: Note: All projects must include at least two sources of information, and these sources must be displayed on the project. URL's are fine to use for now, but ask you English teacher if there is a better way to list references.

Paper guidelines:

Length at least 1.5 pages. Ariel font, size - 12, 1.5 or double-spaced, margins no bigger than 1 inch top, bottom and sides.

Poster guidelines:

No smaller than 20x24 inches. Text information is typed, ariel font size - 12. Diagrams, pictures, drawings should be included, and references to the source must be clear and on the picture. URL is okay to use as a reference for now.

PowerPoint: At least six original slides to cover the topic. *Graphics, pictures, images are important and must have the original source cited.* Choice of font is up to you, however, keep in mind how it will look to the class. Ask yourself: will everyone in the room be able to see it? If the answer is yes, then it is okay to use.

3. You will present your findings to the class in a five minute presentation. After the presentations have been completed you will participate in the discussion of the pros and cons of current and future medical therapies to heal spinal cord injuries. Be prepared to share your thoughts and feelings on the issue.
4. **Completed projects are due in one week on Friday, March 12.**
Late work will lose 10 points per day.

Spinal Cord I Injuries and Society

Scoring Sheet

For Full credit:

- | | |
|-----------|--|
| 10 points | Work submitted on time. When class time was given to work on project, student used the time effectively. |
| 15 points | Project follows guidelines stated in Rubric. |
| 20 points | Description of technology either in use or in development that is designed to help those with spinal cord injuries. Did you answer this question: how does this treatment work to repair damage or assist in mobility? |
| 20 points | The student described in detail some of the challenges that using this technology presents. |
| 20 points | The student fully identified any bioethical controversy surrounding the use of the chosen technology and its applications. Student elaborated and included examples of those who are for and against the use of the treatment. |
| 15 points | Class presentation and participation in discussion. You relayed the topic you investigated to the class and any new treatment that you thought might be effective to treat spinal cord injuries and why. You answered the closing questions in full. You were attentive and respectful of differing opinions presented in class. |

Total possible points: 100

Your Score _____

Student name:

Part C: Commentary on Student Learning

What are the strengths and weaknesses in each student's understanding of the science inquiry processes, as evident from work on the lab?

Student # 1 correctly designed an experiment to test the effect of gender on reaction time and reflexes. He used all of the methods that we had previously used in a class activity. He identified variables that needed to be controlled to get reliable data and mentioned this in the procedure.

Student #2 designed two experiments that would not allow her to connect and compare reflexes and reaction time. She correctly designed an experiment to test reaction time as affected by arm length, but then she tested the reflexes comparing males and females. This would not allow her to compare reaction time to reflexes because she introduced new independent variables in part 2. However, the strength of her inquiry was that she used multiple trials. She failed to include her data in the formal report. When I asked her about this she said that she could not finish it and the STS project. She didn't seem to care because it really didn't affect her score. That's my mistake for setting up the scoring rubric the way that I did. She taught me a lesson on that issue. She defined arm length in her procedure, and she made an attempt to redefine it in her conclusion. This leads me to believe she would modify and improve this experiment if given another shot at it.

While observing Student #1 in class, he was attentive to controlling variables that could affect the outcome. However, he did not document all of these in his report. This is a common mistake he makes often, and I had to remind him of this. Another weakness was the use of a very small sample size to complete his experiment. He did mention this in his conclusion. Because of the design of the experiment, he was able to see that reaction time could possibly be affected by gender, but reflexes are not. His biggest weakness on this lab was not comparing the results of reflexes and reaction time. Looking back I did not specify that in the assignment.

Both students did participate in class during the discussion. Both students demonstrated a knowledge of designing a testable, measurable experiment, control of variables, and the scientific method. Both students recognized the limitations imposed by time and sample resulted in data that really does not give strong evidence. Both students developed data which demonstrated the variability of reaction time. Student #2 explains this on the videotape. A strength of both students is that they required little help in identifying a problem to be investigated which shows their inquisitive nature. I believe that both students will be able to reproduce this type of method on the CAPT next year.

What are the strengths and weaknesses in each student's ability to apply science knowledge to make decisions about science, technology and society issues, as evident from the work on the STS?

Both students chose to examine the relationship and controversy on the issue of stem cells and spinal cord injuries. Both students exhibited strength and weaknesses in their writing. Student #1 showed a critical stance in describing experiments which showed the promise of stem cells to heal neural injuries. His greatest technical weakness was that his writing lacked any real flow and may have been just a string of connected quotes. He did provide references. Student #1 failed to take a personal stance within the writing assignment, but he did actively participate in the class discussion. He did decide to support the development of stem cell technology at public cost to heal those with spinal injuries. Student #2 did a good job examining the issue from a political point of view. She examined the issue from both sides and used examples to highlight her understanding of this technology. She integrated knowledge she acquired not only in this class, but from health class as well. This student used a variety of sources to complete this assignment. She lacked really strong conclusion for or against the use of stem cells but did agree that it should be available to everyone. She did a good job of applying knowledge of the controversy of using human embryonic stem cells, and she came up with a solution to try to solve the problem. At the end of her essay she suggested there may be a way to use stem cells without using human embryos. She offered some information on researchers who are gathering stem cells from discarded umbilical tissue. She recognized that umbilical tissue is not a living organism and therefore would probably not offend those who oppose stem cell research if it means human embryos need to be used.

What are the strengths and weaknesses in each student's understanding of the unit's main science concepts, as evident from work on the unit's assessment?

The differences on the unit assessment were notable. Student #1 earned an 85% on this assessment, and student #2 earned a 69% on the assessment. Student #1's strength was on the objective portions of the assessment. He demonstrated his knowledge of the vocabulary and anatomy of the structures studied. His open-ended answers lacked supporting detail, but demonstrated that he was aware of the concepts discussed in the unit. For example, he answered questions 25 and 26 wrong and was unable to explain membrane potential in detail on question 54. His overall strength was in his knowledge of the vocabulary and anatomy. Although student #2 did not perform well on this assessment, she did demonstrate knowledge of the larger concepts. For example, she had answered question #7 correctly and even changed the term positive to negative to make a correct statement (a type of question asked on the last exam). Student #2 went on to get 25 and 26 wrong but did attempt to reason her way through the problem. I feel these questions were flawed or the diagrams may have been misleading as many students

had these answers wrong while evidence existed that they knew the material. This is one reason why I added three points to the test for the class. Student #2's weakness on this assessment was in the vocabulary, but she demonstrated knowledge of the integration of the nervous system and how it allows the human body to react to stimuli on question 40. She mixed up parasympathetic and sympathetic nervous systems on the fill-in portion and on the open-ended question 55. She did perform well on the draw and label task, even drawing the pathway of the impulse. Her main weakness were significant misconceptions in the vocabulary, and therefore, she could not apply it to the open-ended questions.

Reflection on Teaching and Student Learning

This unit was designed to inform students who have a strong interest in medical field about the role of the Spinal cord and nervous system in responding to the outside world. Biology is a descriptive science, and I wanted to challenge the students to create a controlled experiment to examine reaction time. The lab activity presented a task to the students to design an experiment and collect data. Their results were not dramatic or, in some cases, even correct. However the process was important. While the students were not very expressive in their written answers, with some discussion we were able to come to the conclusion that in a normal healthy person reaction time can be highly variable and reflexes are innate and should always be present, unless there is a problem with the nerves. This is due to reaction time pathways being more complex where the spinal reflexes are simple. In my school there is a strong emphasis on CAPT preparation, and even though these students are in 9th grade I felt a need to emphasize conducting controlled experiments. There are many things I would like to change about this lab. For one, I think I will not use the meter sticks, but rulers instead. Rulers are less cumbersome, and this would allow the students to test people at home and around school. Getting large samples is important for this lab, and in the future this lab will be spread out to allow students to test a variety of subjects. Rulers will affect the data, but only slightly. Another way to modify the lab to increase the contrast between reaction time and spinal reflex is to require the students to examine only the pupillary reflex. I could require the students to grade the reflex as present or absent. Some students were trying to "grade" the reflexes which made the reflex data somewhat confusing. This could be addressed by simply asking the student to grade the knee-jerk reflexes as present or absent. The instructions for the lab need to be modified to ask the students to draw comparisons between reaction time and reflexes. My grading structure seemed to discourage students from analyzing their own data. This needs to be addressed by adding weight to the results/conclusion portion.

The assessment could be improved by adding questions that deal directly with the lab activity. For example, a question would be to explain why the lab groups got a lot of different reaction times, but reflexes did not appear to be different? Students could be challenged to propose a reason based on the nervous system to why the reaction times changed. To take it even further, I should have had the students research what conditions can affect reflexes. I offered these to students as examples, but it is evident that if motivated, students seem to gain a deeper appreciation of the topic when they research it themselves. One thing I learned is that I need to develop stronger alternative assessments. Student #2 did not perform well on the test at the end of the unit, but during the lab and discussion she was able to link how reaction time is affected by the distance

the impulse has to travel. Part of her poor performance on the test came from a lack of clarity on parasympathetic vs sympathetic. Looking back, I did not give enough homework to emphasize these points. In fact I gave less homework than I would normally give because I was concerned about the combined requirements of the lab report and the STS project. I relied heavily on the students to investigate and reinforce the vocabulary on their own. The Word Wall in class is a daily reminder to students to review these terms.

Having students investigate the subject on the "Neuroscience for Kids" website at the beginning of the unit was productive. When we covered the subjects in greater detail, the students had already experienced the terms and had prior knowledge. One of the aspects of this unit I enjoyed was that the teachers I am grouped with in the cluster were open to exploring aspects of the topic. The Math teacher took time to teach the students how to calculate reaction time using the distance data they collected and the formula $y = \frac{1}{2}gt^2$. The Health teacher discussed risk factors for spinal injuries, including driving while intoxicated. Reinforcement of the topics throughout the school day contributed to student learning. I think that in the future I will encourage more cooperative planning among the teachers I am grouped with.

A reason I feel this unit is relevant to my students is that many of them live in areas where street violence is a reality. I was surprised to hear a student during the discussion express how having a family member who lives with a spinal cord injury has affected her views on treatment. This is another example of how at ease my students are in class. I attribute this to school culture and a strong effort by my to implement the "Capturing Kids Hearts" program. This program of classroom management seeks to create a safe classroom environment which encourages students to take risks. You will notice on the video how my students support each other by never letting a student "stand alone" at the front of the class. Students spontaneously clapped for each other when another student makes a valid point or takes a risk by sharing their views in class.

Being new to this school, grade level, and block scheduling, I have made several adjustments to my teaching style over the last year. For instance, I have the students participate in activities that allow them to explore without set instructions and rigid questions to guide them through the activity. We then discuss the findings as a class and come to a conclusion. One example was the activity using the funnel with different diameter tubes to model axon transmission and how it affects the speed of conduction. The performance of students on the assessment confirms this. The use of the SmartBoard in my classroom has really changed my teaching. It allows the class to move through larger amounts of material faster because I can integrate notes and bullet points with images and diagrams a lot better than using an overhead and the board. It also allows me to "save" the material that was presented in class, including any modifications and adjustments I made in response to students understanding. This came in very handy because due to wild weather. There were quite a

few absences in this class during the week. Considering how much material and vocabulary we covered, the class as a whole performed well. I feel this daily routine of keeping a hard copy of what was done in class then distributing to the students when they return allows them to focus on what material is important. Outside of school my students have little access to technology.

A drawback of the block schedule is that there is no free period during the day for students to use the computer lab. I have to continue to allow class time for students to complete the required work. One thing that surprised me was how interested students were in the project and how much they shared during the discussion. I was impressed by the student who offered that stem cells could be harvested from umbilical tissue thereby avoiding the whole argument of using human embryos. She took the extra step which was not part of the project requirements (maybe it should be next time) to offer a solution to a bioethical problem. Student#1 had produced a report that was below what I expected from him. He completed the written project earlier than was required, but he kept investigating the subject. During the class discussion, he offered information that a treatment is being developed to treat damaged nerves using nasal neurons. This was in response to the issue that not all treatment needs to come from human embryos. I brought a lot of my professional experience as a health care professional into the classroom during this unit. Students were asked to treat the experimental subjects as their patients and ask permission to insure maximum patient comfort. I emphasized that the students use correct techniques for reflex testing. I specifically left out reflex grading because it is not necessary to teach to students at this level and would detract from the unit material. Teaching students the Jendrassik maneuver helps to reinforce the concept that the brain can affect our reflexes, and this simple distraction to the brain allows the examiner to view the reflexes.